Hall., G. S.

Laura Bridgman.

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PSYCHOLOGY AND PHILOSOPHY.

I.—LAURA BRIDGMAN.

IN 1837 a delicate light-haired girl, nearly eight years old, who at the age of 26 months had lost sight, hearing, and to a great extent the senses of smell and taste, from an attack of scarlet fever, was brought from her rural home in New Hampshire to the Perkins Institution for the Blind in Boston. During her long illness all recollection of her babyhood had been completely effaced. Her parents had communicated with her by the simplest signs addressed to her only sense of touch. A pat on the head expressed approval, on the back disapproval. She had been taught to sew, knit, braid, and assist in trifling ways about the work of a farmhouse. Dr. Howe began her instruction by pasting on common objects—chair, spoon, stove, &c.,—their names printed in raised letters. After she had associated the name and the object the labels were taken off, and she was taught to select the object for a corresponding name and *vice versâ.* After a few days, when she had thus learned a small number of names and objects, Dr. Howe gave her a pin and a pen and made her feel his hands as he spelled from *disconnected* letters the two corresponding words. After repeating this process scores of times she suddenly seemed to understand that the signs were complex and must be observed separately, and at last she was able to select from a pile of letters those which spell 'pin' or 'pen' according as one or the other object was given her

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This was an immense step. She was now easily taught the names of many other things and to set up types of raised letters, and impressing them upon paper to produce a copy which she could read on the reverse side. After nearly two years of such exercises she was taught words indicative of quality, as 'hard' and 'soft,' and, later, moral qualities, commencing with the figurative use of the words 'sweet' and 'sour,' which as tastes she could slightly distinguish. It was difficult to explain to her why these should precede the substantive, and especially so to make her understand general or abstract expressions of quality, as 'hardness,' 'softness'. Next she was taught words expressive of simple space-relations 'on,' 'in,' 'under,' &c., and later and very easily the use of verbs expressing tangible actions, as 'walk,' 'run,' 'sew,' first in the present indicative and then in other moods and tenses. Instruction in writing which began at this point was at first very puzzling to her, but when she suddenly caught the idea that thus she might communicate with persons whom she did not actually touch, her enthusiasm was great and her progress rapid. Counting, the divisions of time, the simple rules of arithmetic, and, later, fractions and the computation of interest, the elements of algebra and geography, &c., she has been able to comprehend quite clearly.

We have no space to epitomise further the history of her education contained in Dr. Howe's Reports,[1] unfortunately now mostly out of print. His work was so ingenious and successful that it still remains one of the greatest triumphs of paedagogic skill, and his studies of his pupil during the most interesting period of her education may be called almost classical for the psychologist. Few princes have had more devoted pains bestowed on their education. Besides Dr. Howe's personal and constant supervision, an accomplished lady-teacher, who has lately published an interesting sketch of Laura's Life and Education,[2] was engaged for years expressly for her. Laura's curiosity has always been boundless, and she is so demonstrative and affectionate, and so pitiable from the afflictions which have made her famous, that the number of her personal friends and acquaintances has become surprisingly great, while not a few ladies have learned the deaf and dumb alphabet mainly in order to converse with her. The philanthropic interest of Dr. Howe in his pupil (whom he described as living in isolation from all that is best in the intercourse with men and nature, as if at the bottom of a deep well striving to grasp the slender cord by which he at last slowly drew her up into the world of human fellowship) was contagious, and thirty years ago his annual reports of her progress were translated into several European languages and read by thousands with an interest and a sympathy which has been described as creditable to humanity. Her native modesty and conscientiousness, her remarkable cheerfulness and love of every sort of sport and play which she can understand, scarcely less pronounced now in the woman of forty-nine than it was in the girl of sixteen, the amazing rapidity with which she comprehends and uses the deaf and dumb alphabet (sometimes receiving through the hand of an expert teacher every word of a public address as it is given with the loss of scarcely a letter), the decided enlargement of her head in the frontal regions during the early years of her education, her dreams in the finger-language, her curious and expressive vocal sounds, gestures, and facial expressions, the readiness with which she remembers old acquaintances after the lapse of years by the mere touch of the hand,—these and many other facts have been cited and commented upon by scores of writers until it is hardly extravagant to say that comparatively few comprehensive treatises in any department of mental or moral philosophy or psychology written in Europe or America during the last quarter of a century can be found without the mention of her name. Her education has of course always been chiefly in language; yet, like all the blind, and still more those who are both deaf and blind, she is quite nominalistic in her modes of thought, and by no means a mere parrot or word-monger. A word to her, though not a mere *flatus vocis*, is yet only a representation of something definite, specific, and for the most part tangible. It has been often conjectured that intensity and range of emotion depend in some measure upon the intensity and range of the voice, the mobility of the features, &c. The capacities of the hand, physiologically the most objective part of the body, are so different as an organ of expression from those of the larynx that, if this be at all true, we can see here an additional reason why her strange consciousness is at every point so like yet so unlike our own, that we might compare the two as Mr. Herbert Spencer conceives things *per se* may be related to our perceptions of them, *viz.*, as solid objects casting their shadow upon a cylindrical surface where lines and angles are all represented, but in such changed relations and proportions that there is an element of incommensurability between thing and thought at every point.

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[1] The last Report, issued just before Dr. Howe's death, was reprinted in MIND II., pp. 263-7.

[2] *Life and Education of Laura Dewey Bridgman.* By MARY SWIFT LAMSON. Boston: N.E. Pub. Co. 1878.

For years Laura was encouraged to write down every day her experiences, acquisitions and reflections, and her teachers were also in the habit of keeping a diary of her progress. She has

also at different periods of her life written three "autobiographies," two of which are mainly devoted to the recollections of child-life at home. She has had quite an extensive correspondence and many of her letters have been collected and preserved by friends. Unhappily very little of this copious material except her own diary and the reports of Dr. Howe has been used by Mrs. Lamson in her recent sketch. Through the kindness of Dr. Anagnos, the successor and son-in-law of Dr. Howe, it was all placed in the writer's hands; and the hospitality of the Perkins Institute for several weeks, together with all needed assistance and information, was generously offered for further observation and experiment. A preliminary sketch of some of the methods and results of these it is now the object of the present article to give. Most of Laura's life has been passed in an atmosphere of womanly sympathy, and the question whether or not she should be submitted to the trifling inconvenience necessary to any psycho-physiological study of her sensations, which may seem to some to bring humanitarian and scientific motives in conflict, appears quite impertinent when we reflect that perhaps no person living owes more to the kindness of her fellow-beings, and that few are less able to repay it otherwise.

During the first twenty-six months of her life, before the illness in which the contents of her eye-balls and ears were discharged by suppuration, she is described as a somewhat precocious child with light blue eyes and an almost morbidly active and sensitive temperament, who had already learned a larger stock of words than most children of that age. Very many adults remember distinct events before the beginning of their third year, and several well-authenticated cases are on record of those who became blind from the sixth to the eighth year, and whose memory of visual conceptions and colour-sensations has persisted through adult years. After carefully questioning her mother and other relatives who have always been interested in these questions, and after several short series of indirect and scores of direct questions addressed to Laura herself with the request that she would "think hard" and answer in writing the next day, and after examining the three "autobiographies" in which she has at different periods of her life striven to recall all traces of early recollections, no reason can be found to believe that any thing whatever previous to the long convalescence which extended from her third to her sixth year has remained or can ever be recalled to her memory. Yet, when we reflect on the amazingly rapid self-education of infantile life through the senses and its fundamental nature, it is impossible to believe that its effect can ever be entirely obliterated. In fact we may recognise in Laura's strange and insatiable curiosity, especially about things which others see and hear, as well as in the suddenness with which insights have so often seemed to break in upon her mind, some sort of sub-conscious reminiscences flashing through the sad background of her childish recollections.

Of the next period of her life, extending to the end of her eighth year, when her education commenced, her memory has always been wonderfully full and complete. In the "autobiography" of 1854 more than forty large and finely written pages are devoted to this period, and a comparison of this with the others, and with her answers to questions based on their contents, shows that she is able to recount still additional details. There is every reason to believe that these are veritable recollections, and that they are not confused with accounts of her childhood rehearsed to her later by parents and friends. She seems to have taken the greatest pleasure in recalling and reflecting upon her early life from the higher standpoint of her *articulate* consciousness, and in recording the events in her quaint and latinistic style. She remembers that she "often subsisted upon many sorts of berries with most luxurious milk in the summer"; how she loved to "reach a great abundance of sour and sweet apples suspending on the branches of the trees"; how "I enjoyed myself exceedingly in observing her [my mother] spin, weave and wind yarns, and doing other things exceedingly," and regretted that "I could not perform the latter for it seemed prodigious"; how much "difficulty it yielded me to make myself understood"; how in a fit of passion "I rejected the poor cat vehemently into the fire". "I was intimately acquainted with my grandfather, who was my male parent's father." She describes the capes, ruffles and bindings of her dresses and those of her friends; tries to explain the process of making candles and soap; remembers pounding up beetles and caterpillars in her mother's mortar, how she used to dress up a boot as a doll, her adventures with domestic animals, her sports, occupations, punishments, medicines and presents, the wrinkles on the hands and faces of her friends, the slender stock of signs by which she communicated with others, and how she strove often vainly to make her wants understood; and pauses occasionally in the narration to wonder at and deplore with a sort of self-pity the ignorance of her early life, or to apologise for that of a quaint old bachelor-friend, who was very kind to her. Her psychical processes during these years, complex as they were, went on and were remembered entirely without the aid of language, which differs from other series of gestures only in being more explicit and capable of development, and in introducing into or imposing upon conscious thought a new logical order. Gesture in general has been described as a language of roots still

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more primæval than those which philologists seek to determine. Like articulate speech, it is a reflex of apperception, and is demonstrative or predicative, may be very express, or may be reduced to the slightest terms of motor innervation, and has its own distinct syntax, determined perhaps for the most part, as Geiger believed that of oral language to be, by the order in which phenomena affected and interested the sense of sight. Hence in these memoirs of her early life, Laura merely translates a less into a more perfect series of reactions and innervations—a process which probably does not differ so much from the case of a normal adult recalling and reflectively recording his earliest recollections, as language through the fingers and their cerebral centres differs from language through the vocal organs and the island of Reil. At least it will be admitted that Laura's education at first revealed quite as much as it created intelligence, and we must wonder at her remarkable endowments, while we none the less admire the ingenious method by which she was saved from a life of isolation, which would otherwise almost certainly have ended in morbid irritability, melancholy, and finally in insanity or idiocy.

It has been often asked whether she is absolutely deaf or blind, and what is the present condition of her ears and eyes? The eminent Boston aurist, Dr. Clarence J. Blake, who kindly consented at the writer's request to examine her ears, reported as follows:—"Both external ears normal. The right external auditory canal normal in size and contour, and the skin lining the passage healthy and showing no marks of previous inflammation-processes. The right membrana tympani was entirely destroyed with the exception of a narrow rim, the remains of the inferior and posterior portions of the membrane, from which a thin cicatricial tissue extended inward to the promontorium over the stapes and fenestra rotunda. The malleus and incus had disappeared. The mucous membrane of the tympanic cavity presented a normal appearance with the exception of one spot on the promontorium covered with a thin crust of dried secretion about two millimetres in diameter. A band of thin cicatricial tissue also extended across the anterior portion of the tympanic cavity. The left external auditory canal was filled with dark brownish cerumen, on removal of which the passage was found to terminate at a depth of two centimetres in a diaphragm of secondary granulation-tissue completely closing the canal. This diaphragm was concave, very firm, and resisting gentle pressure with a probe, except at the central or thinner portions, where it could be slightly depressed. Its outer covering was continuous with the dermoid lining of the canal." The tests of her sensations of sound were made first with a tuningfork, with movable clamps and set in vibration by a spring hammer. The stem of the fork was placed between her teeth (false) and pressed against an ordinary telephone-disc, resting successively upon each mastoid process, over the forehead, at the junction of the frontal and sagittal sutures, over the vertex and the occiput. Heavier tuning-forks were afterwards used in the same way, and also in connexion with a series of Helmholtz resonators, the points of which were introduced into the ear (for the use of which and other physiological apparatus the writer was indebted to the kindness of Professor H. P. Bowditch). The most piercing tones of König's rods and the deafening noise produced by slipping the moistened fingers over the end of a toy telephone, one mouth-piece of which covered the external ear, were tried. A large pasteboard trumpet, like those of a megaphone, though smaller, fitted to the osseous socket of the ear, such as has been so useful in some cases of deafness, was used; and finally electrical irritations were applied to the external ear and sent through various parts of the brain. But all in vain. Once or twice her feeling was described as "like singing" or "as if some one was speaking," but it was generally very certain that her only sensation was that of vibration or jar. Her sensitiveness for the latter is very acute. She commonly describes herself as hearing "through the feet". In this way she distinguishes not only the step but sometimes even the voice of her acquaintances.

From a rough preliminary experiment it would seem that she is able to distinguish a musical interval of somewhat less than an octave by the sense of touch through the end of the index finger of the right hand, and yet this sense does not appear to recognise sonorous vibrations of less amplitude than normal persons can do in the same way; thus, although she lives in an absolute stillness, which, according to the speculations of Preyer, a hearing person can never even for an instant attain, she attaches a very definite meaning to the words 'sound' and 'hear'. She also feels of course the vibrations in her own throat when she makes her "noises". With sensations which in this respect are perhaps scarcely above the average, she is able, without the distractions which continually enter through the normal ear and eye, to concentrate attention upon the meagre data until she has developed a set of perceptions and conceptions so little incommensurate with the ordinary auditory consciousness that they do duty for it to a surprising though still slight extent. Of the physiological basis of this sense of vibration or jarring almost nothing is as yet known. It appears to have some of the characteristics of a distinct and specific and some of a generic sense. Investigations already begun in one of the German laboratories may increase our knowledge of its nature.

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If oscillations as such can be directly felt, then the most generic fact of the physical world enters consciousness immediately without passing any "inconceivable chasm".

Dr. O. F. Wadsworth, an accomplished oculist of Boston, who kindly consented to examine her eyes, reports as follows:—"On both sides the lids are sunken, partly on account of lack of the normal amount of orbital fatty tissue. Partly on account of the small size of the eye-balls, they remain constantly closed. The right conjunctival sac is much smaller than normal, somewhat irregular, and presents an appearance such as is seen after severe and long continued inflammation. The right eye appears about one-half the normal size. It is wholly enclosed by the sclerotica, except over a space at the centre some two millimetres in diameter, where a less opaque tissue on which a few blood-vessels are visible represents the altered remnant of the cornea. The left conjunctival sac is somewhat larger than the right, and more regular, though still small. The left globe also is a little larger than the right, and its opaque altered cornea is some four mm. in horizontal and two mm. in vertical diameter. There was constant irregular oscillation of the globes (nystagmus) whenever they were exposed to view by raising the lids, and the oscillation evidently continued even after the lids were closed." Possibly this was due in part to the excitement of the visit. The sensitiveness of the eyes was still further tested by a ray of sunlight directed to each ball (after the lids had been raised) from a heliostat, and gradually concentrated until the point of almost painful heat was reached; but with no trace of any but a slight "stinging" sensation in the left ball. Gentle pressure and electrical irritation applied both to the orbits and directed through the visual centres produced no effect whatever. During her childhood at home she was just able to distinguish lights and windows in a room and (her mother thinks) to recognise people dressed in white, but these sensations were so feeble that she seems almost never to have utilised them in directing her motions; and even these seem to have been lost soon after she went to the Asylum. She has always, however, especially in bright sunlight, complained of a slight "pricking like needles" in the left eye. Partly for this reason, but chiefly to cover the shrunken globes, she wore constantly for many years a band of heavy green silk bound over both eyes. It is thus manifestly impossible that any, unless it be the most rudimentary, visual impressions can have directly entered as factors into her intellectual development. Hence her notion of colour is even more purely conventional than that of sound. She remembers having learned that mosquitoes, the wind, certain animals, and impacts make a noise, but did not know, or had forgotten, that flies, running water, rubbing the hands, &c., did, and was uncertain about many other things. So she remembers the names of the colours of her dresses, flowers, sky, grass, blood, and often insists that certain garments are too light for winter or too brightly coloured for one of her age. All this, however, is merely conventional and verbal. She has never formed any mental conception of what colour is or is like, as do so many of the blind. It was never in her mind identified with or even analogous to any notion or sensation of sound, smell, taste, or touch, as with so many who have only some or all of their senses.

Whether from her conceptions of space-relations the influence of previous visual impressions has been entirely lost is one of the most difficult and important questions. She is far less "blind-minded" than many of the congenitally blind, yet she forms conceptions of aggregates with difficulty. She knows that her room is square, but is not certain that the house is so. She can form a very poor image of how the grounds with which she is perfectly familiar would look from a house-top, has a very poor notion of perspective, knows very little why or how much objects look smaller at a distance, and is unable to tell without much reflection how many sides of a hexagonal column can be seen from one point of view, though she has learned well that rays of light move in straight lines. In spite of her wonderful powers of recalling past sensations, even those of her childhood, she remembers nothing of seeing, though it is quite impossible to believe that the very many and complex motor reactions and co-ordinations which a bright child learns by means of this sense before the age of two years can have been entirely lost. These, and not the small though essential factors of sensation, constitute education in its enduring results. She turns the head but very slightly in the direction in which her attention is excited, but invariably extends one hand. The irregular motions of the remnant of her eye-balls have also no psychical significance. But the occult effects of the early possession of vision are to be found, if at all, in her wonderful memory for forms and in her perpetual craving for a fuller and larger knowledge than it is possible to convey to her, which rises at times almost to question-mania [*Grübelsucht*]. Even on the basis of the Berkeleyan theory it would be expected that a knowledge of the external world derived through touch and muscle-sense alone would be more *serial* than where the broader and more rapid perceptive processes developed through the visual centres come in, to review, epitomise and extend impressions from without. The question also arises whether a person with for years only a very vague sense of intense light and using this to anticipate tactile impressions, *e.g.*, to avoid the fire and go towards the window, &c.,

would not get through the eye a better because far more serviceable idea of the third dimension of space than of the other two.

The inflammation of the olfactory mucous membrane during her long illness was severe, and the sense of smell was almost entirely lost, though it has slightly improved with advancing years. She has never had the habit which so many blind persons acquire of testing objects by applying them to the nostrils. There is however no deformity or scarification observable without or from a cursory examination within the nose, and the yellow pigment of the schneiderian membrane can be faintly seen by a simple apparatus. According to the very questionable hypothesis of Dr. W. Ogle, this sense might from the first have been rudimentary in a person of her complexion. Her mother, however, does not remember to have noticed during her infancy either the presence or absence of this sense, although the latter would probably have been more conspicuous. At present she loves to smell flowers, and can distinguish a few of the more fragrant varieties. Eau-de-cologne, ammonia, onions, tobacco-smoke, were recognised and distinguished only when quite strong, and the same was true of aromatic flavours. In losing the sense of smell, in some respects the most delicate and the most wonderful (perhaps because the least known) of all the senses, she is deprived of a means of communication with the objective world of the greatest importance to one in her condition. Julia Brace and other blind deaf-mutes have been able to sort the freshly washed clothes of the inmates of a large asylum, and to select and give to their owners several dozen pairs of gloves thrown promiscuously upon a table, solely or mainly by the sense of smell. A hasty experiment with Laura to determine whether smell was more acute in inhalation or exhalation was without result. The sense in both nostrils is about equally intense, and once when eau-de-cologne was applied to one nostril and tobacco to the other, she recognised both. Whether this was done more or less readily than would have been the case if the odour of both had been inhaled with equal strength by both nostrils at the same time seems by no means certain.

Taste is not so much a single sense as a plexus of senses. To sensations of cool, biting and astringent substances, pepper, alum, &c., located in the gums as well as in other parts of the mouth, she is very sensitive; to flavours perceived in the nasal cavity far less so; and of the four tastes proper she seems least sensitive to bitter and sour, most so to sweet and salt; while the observation that the base of the tongue is most sensitive to the first of these tastes, the sides to the second, and the point to the third and fourth appears to have partial verification in her case. She also experiences the peculiar taste caused by electrical stimulation; she is however very far from being indifferent to the kind and quality of her food, but satisfies the very moderate demands of her appetite with a deliberate and almost epicurean discrimination, which suggests the existence of what Professor Bain describes as sense of relish, quite apart from taste proper, and felt perhaps most keenly just as food is leaving or just after it has left the region of the voluntary and entered that of the involuntary muscles of deglutition. The circumvallate papillae have about the same superficial appearance as on an ordinary tongue, perhaps smaller but scarcely less numerous. Both this sense and smell have a strange intermittency, which resembles that of the higher senses and of the intelligence itself in many forms of nervous and mental disease. In making the above observations, both, especially taste, after being considerably acute for several minutes, often seemed suddenly and unaccountably to vanish and no trace of sensation could be observed under very strong stimulus. It would be very interesting to know what sort of a curve of fatigue, if any, such modifications of sensibility follow. It may be analogous to the speedy rigidity of the hand in contact with the cathode when a strong galvanic current is sent through both arms, in Ritter's well-known experiment which Pflüger has so ingeniously explained.

From the above we feel justified in inferring that the lesions of each of the four defective senses were primarily peripheral and so complete that none but taste has essentially contributed in developing her consciousness of the external world, while the functions of the centres, already somewhat unfolded though so slightly localised as they are in children of two years, adapted themselves with less than usual loss of power to their new and unfavourable conditions. The time for such a four-fold affliction was perhaps the most favourable possible. Had it fallen earlier the physiological development of the centres might have been still more dwarfed and the impulse toward mental growth still feebler; had it come later, together with a possible diminution of vicarious and adaptive power, the memory of loss would have perpetually saddened her now exceptionally happy and buoyant spirits, and she would never have been able to forget, as she seems completely to have done, that what others know as a manifold objective world she is doomed to perceive only as a play of shadows across the narrow field of a single sense. The time of her discovery by Dr. Howe and the beginning of her education at the age of eight seem also very opportune. She had had time to recover from her long illness, and to learn much about things concerning which she had already begun to feel a strong and ungratified curiosity.

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Her desire at one time to have a mirror in her room, the pleasure she experiences in feeling a little music-box as it plays in her hand, her love of having perfumes and of eating things like certain jellies, farina, &c., which can have little or no taste to her, have been called affectations, but are inevitable results of association with normal people. An *esprit de corps* is as unfortunate among defectives as among prisoners. Among the blind or deaf Laura has had comparatively few acquaintanceships, considering that so much of her life has been passed at an asylum. Only the case of the mirror can be called pure affectation, while even her "taste" of jellies seems largely due to the purely æsthetic feelings of touch in the mouth. Wundt's ingenious theory of facial expression, *viz.*, that it originates in movements calculated to modify vision, smelling, taste, and in part hearing, is not favoured by observations on Laura. True, she does not open the mouth in the ordinary way to indicate great attention or surprise, and the upper part of the face and forehead, as compared with that of most of the blind, is quite immobile; but she can hardly have learned to draw the lips and cheeks toward either side away from the gustatory surface of the edges of the tongue because sour is tasted there. Nor can the mimesis of her nostrils be explained without making large drafts upon the principle of heredity. All the lower part of her face is extremely mobile and expressive, as with most of the blind, in spite of constant effort on the part of her teachers to check unpleasant excesses. Lack of sympathy and cruelty have been observed as frequent characteristics of the deaf, and are no doubt due largely to the fact that human sentiments and all the finer feelings and emotions are mainly conveyed through the voice: no one however can doubt, despite the several instances of cruelty recorded of her childhood, that Laura's nature is unusually sympathetic. She often fails to understand readily the feelings of others, but when they are made clear, the response is far too quick and hearty to be for a moment considered as merely conventional.

Local discriminations through the skin are developed with remarkable and in some respects unprecedented acuteness. Discrimination of peripheral sensibility in a normal person ranges from about 68mm. between the shoulders, to ·0005mm. on the *fovea centralis* of the eye. (If we mentally construe all these forms and degrees of sense into terms of touch, as they may perhaps primitively have been, we shall be able to conceive how great is Laura's disadvantage in communicating with the external world.) Now it is well understood that of Fechner's methods of measuring sensibility that of the *average error* gives the lower, and that of the *just observable difference* gives the upper threshold-value, while that of the *right and wrong cases* gives results which fall near the middle of the thus quite extended threshold. In choosing the second of these methods it is desirable that the series of measurements be a descending one: *i.e.*, the points of the pair of compasses must be gradually approximated till the sensation of two points gives place to that of one. In this way the threshold-value is less than if the series be reversed. Proceeding thus, it was found that Laura was able to distinguish two points at a distance of 0·502mm. on the point of the tongue—an average of twenty-four observations; at a distance of 0·708mm. on the volar side of the end of the right fore-finger—an average of thirty-seven observations; at a distance of 1·2mm. on the inside of the red edge of the lips—an average of eight observations; at a distance of 1·6mm. on the outside of the lips—same number of observations; at a distance of 1·51mm. on the end of the second finger—eight observations; 1·8mm. at the end of the third finger—eight observations; 1·9mm. at the end of the fourth finger. On the upper lip just above the end of the mouth she distinguishes an interval of 3·5mm., at the back of the tongue 4mm., on the forehead between the eyebrows transversely 6·71mm., on the tip of the nose 1·7mm., on the point of the cheek bone 3·04mm., each of the last five measurements being averages of twelve observations made on three different days.

By comparing these results with Weber's tables, it will be seen that tactile sensibility in most of the places measured is from two to three times as great as that of an ordinary person. In making the above observations, however, it must be noted that a strange variation of sensibility was observed, which was so great as to make the preliminary results here given reliable only in proportion to the number of single measurements from which they were averaged. Sometimes, with the utmost apparent straining of attention, the discriminations were less than half as acute as at others. So great is this variability that it is hoped that a curve of fatigue may be obtained by which some approximate comparison with the fatigue-curve of a nerve-muscle preparation may be made. We may already infer however that the exceptional acuteness of this sense, in Laura, is centrally and not peripherally conditioned. It is probably due to the unusual energy with which she has learned to concentrate attention upon the sensations of fingers, tongue, &c. It was often observed that the *Empfindungs-Kreise* were ellipsoidal and not round, the longer axes coinciding with that of the body or limb;[1] and that, when one point of the compasses was rotated

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[1] Czermak's explanation of this general fact, *viz.*, that these sensory domains are round in children and become oval because growth is propor-

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about the other, at a distance of only one-sixth that of a diameter of the *Empfindungs-Kreis* within which they were placed, the sensation of motion was distinctly felt. The habitual exploring touch-motions *(prüfende Tastbewegungen)* which, as with most of the blind, are almost irrepressible with her during such experiments, has perhaps made her more sensitive also in this respect than others, although this point has never been investigated. It was very evident, before the writer's observations were interrupted, that there were strange and sometimes abrupt variations from the tactile sensibility of a normal person in certain accessible parts of the skin which were neither scarred, nor ever in any way, so far as could be learned, injured or diseased. These spots are so obtuse in the discrimination of local signs and local colour as to suggest the question whether certain slight twitches often observed in various muscular groups, which according to the radical nomenclature of Hughlings Jackson must be called epileptical, together with certain other almost equally mild hysterical symptoms, may not have had the result which is so common in severe forms of these disorders, *viz.*, partial and more or less distinctly defined dermal anæsthesis. Laura has in the hands and face a sensitiveness to ordinarily imperceptible and sometimes imaginary dust which very closely resembles, save in degree, that described by Charcot and Westphal as one of the characteristic symptoms of incipient mania. Her touch is thus so acute that it is not surprising that she estimates the age of her visitors by feeling the wrinkles about the eyes, and tells the frame of mind of her friends by touching their faces, nearly as accurately as a seeing person could do. From the tonicity of the muscles or the movements of the hand she conjectures the grade of intelligence of her visitors, and long ago learned to detect almost instantly the hand of an idiot by its peculiar flabbiness. She tells readily the time of day by feeling her watch, remembers the hands of her friends for years. A few of the figures of Zoellner and Hering were found to be as deceptive to the touch of the blind when pricked on paper as to vision. It has been said, on the authority of Professor Abbott in *Sight and Touch,* that if a flat surface be pressed with the fingers first gently, then hard, then gently, and again hard, gently, hard, it will seem in the one case convex and in the other

tionately greater in length than in circumference, seems partial. Most of our motions both of the body and limbs are in a horizontal plane, *i.e.*, at right angles to the long axis of these domains ; hence that direction grows more sensitive. Moreover, as Horwicz well remarks in commenting on the proven inaccuracy of Vierordt's law, frequency of use is a co-factor with mobility and original nervous structure in determining the sensitiveness of different parts of the body.

concave: this after many attempts the writer was unable to verify with Laura or in a single case with a score or two of the blind.

Her sensitiveness to heat is below the average. She certainly could never distinguish colours by difference in their powers of radiating heat. It has been observed that when seeing people are blindfolded they are able to tell which of five or six familiar and previously named objects is held before the face at a distance of from one to three or four feet. A book, a folded handkerchief, a scrap of sheet-iron and a piece of gauze, *e.g.*, all of about the same surface-measurement, are distinguished in this way, as well as the side of the face towards which they are held, by a friend of the writer almost invariably at a distance of four feet in a darkened room, and with every precaution to avoid giving any clue to the eye or *ear*. Is this due to the modification of half imperceptible sound-waves affecting the tympanum or to changes of thermal radiation from the skin or to modification of atmospheric pressure? Laura has very little of this power, but observations on the deaf have shown that some of them possess it to a great degree. Moreover it should not be forgotten that the ear is a bad judge of direction; hence we must assume that other elements enter in as the data of sensuous judgment in this phenomenon. Only a cursory examination of the dermal sensibility to temperature, pressure and electrical stimulation was made, but this indicated in each of these respects, and especially the last, a degree of sensibility below rather than above the normal. Finally, it may be mentioned that, from a short series of measurements which a lady-attendant kindly consented to take upon parts of the body usually covered by clothing, it would seem that here the discriminating sensibility, though decidedly above the average, is much less so than in the more sensitive parts of the hands and face. In applying the compasses to one arm a concomitant increase of sensitiveness was observed on the corresponding part of the other.

To test the sense of equilibrium, an ordinary swing with a long board, pillowed and provided with a foot-piece, was used, on which she consented to be rotated, lying upon her back, her face and both sides. In each of these positions, after being turned through 180° and then gently placed upon her feet, there was a very evident disturbance of muscular coordination, and she insisted that she was very dizzy. On rotating her through 270°, she was hardly able to stand without support and complained of nausea, describing herself very vividly by gestures and language as seeming to "turn over" in the same plane in which she had been rotated, but in an opposite direction: of the genuineness of these sensations, her ignorance of

the object of the experiments and of the normal muscular movements of compensation leaves no reasonable doubt. The dizziness, it was further observed, must be considerable before the power of correct orientation was lost. She was able to tell more correctly than several normal persons who afterwards tried the experiment upon themselves blindfolded, whether she had been turned through half or three quarters of a circle. She was equally sensitive to rotation in a horizontal plane. By so *ex tempore* a method it is of course impossible to exclude, as Mach has at least partially done, the influence of tactile sensations caused by friction, and the process of standing her suddenly upon her feet after every rotation complicates the disturbance: but it is impossible to doubt that she is so extremely sensitive to disturbance of equilibrium, in which both the deaf and the blind are often deficient, as to compel the belief that, upon the hypothesis of Goltz and Mach, her labyrinthine impressions are at least normally acute, and to make a *post mortem* examination of the semi-circular canals with their nerve and its putative centres extremely desirable. She does not appear to be in the least ataxic, but it will be remarkable if touch and muscle-sense have, in addition to all their other vicarious functions, so well learned to discharge those now generally supposed to be due to endolymphic pressure. She can walk alone very nearly in a straight line, and without deviating more often to one side than the other, though always with a hesitating but not unsteady step; she takes long daily walks with her attendant, looks after her own room, goes freely all over a large house, and in any place with which she is familiar knows the points of the compass.

The more strictly organic sensations are not accessible to exact measurement. Even the muscle-sense or feeling of innervation, which even in the case of a normal person and still more in her is so largely instrumental in the work of objective perception and which seems to be so exquisitely delicate in her hands, cannot be directly tested. When told to extend the fore finger and move it as slightly as possible, she makes motions which the eye can but just detect. When the arm or hand is taken and moved through a fixed distance, as an inch or a foot, and she is requested to measure off the distance on a smooth glass rod, she does so with considerable accuracy, although this, like all her similarly indicated estimates of distance, are slightly less than fact. When the compasses are applied to hand, arm, or shoulder-blade, with their points separated in each case about three-times the least discernible distance, and she tries to reproduce these intervals in terms of muscle-sense by measurement on the glass rod, it is found that she invariably judges the greater distances to be proportionally less than the smaller. We cannot infer from this that her notion of the form of her own body is different from the reality on account of the variable discriminative sensibility of the skin. There are very many ways in which this tendency would be corrected in the blind. Yet when asked to make a series of straight marks, *e.g.*, two inches long and two inches apart, the first pair with the hand in the ordinary manner of writing, the next in a constrained position writing on pasteboard pressed against her back and so on alternately,—the marks made in the latter position were found, in an average of over thirty cases, slightly shorter and slightly nearer together. It would be very interesting to compare these results with those obtained with a large number of normal persons. Like many women of somewhat delicate health, she appears very susceptible to other organic sensations, and though subtle inferences might be drawn about semi- or sub-conscious states and processes from her moods which vary considerably, she seems never to have developed, as a late writer asserts is almost inevitable among those whose sphere of objective mental life is abnormally circumscribed, any " liver-consciousness," or " heart-consciousness," or "stomach-consciousness". She has never, so far as is known, shown any special trace of hypochondria or hysteria, or even melancholia, and in everything sexual her education has been so discreet, that the innocence and purity of her thought and life are said by those who know her best to be absolute and even unique. One of the most common notions developed among the blind when they are left much to associate with each other is that they have one real advantage over the seeing in that they are free from all species of optical illusion, and thus, although they know less, their knowledge is more untheoretical and realistic. In this way Laura's is in a double sense realistic and objective. All her knowledge is literally *handgreiflich.* Touch seldom deceives or misinforms and its *rapport* with things is most immediate; hence she clings to all its impressions, even when told they are wrong, with great pertinacity.

The physiological theory of language regards it as originally an immediate motor reflex of sensations perhaps mainly visual, and as being thus a more or less complex series of gestures which soon come to acquire a special auditory significance as a condition of a remarkable subsequent development. Regarding words as gestures, it would once have been comparatively easy to teach Laura by such manipulation of the organs of speech as Graham Bell has applied in teaching the deaf to talk. By this method, with the use of a manipulator, the writer taught her in half an hour to articulate the words " good day " intelligibly, but the next day they were quite forgotten. She is now too

old and too adept with the finger-language to make a new method of speech possible. She learned long ago, by feeling the throat and mouth of others and by their help, to pronounce three or four words quite well, and has never forgotten how to say "doctor," "Peter," "money". She has also half a score of "noises," designating persons. These seem to be produced by translating the complex of impressions, or more strictly sensations, which others excite in her into the movement-feeling of 'throat-gestures,' and thus they are very analogous to cases of so called 'indirect onomatopoieses'. Still more interesting however are the instructive and utterly unconscious sounds, which Dr. Lieber took so much pains to investigate, that do not designate objects but express her own feelings. These to the number of nearly thirty the writer attempted, with the kind assistance of Miss Fuller, principal of the Horace Mann school of deaf mutes in Boston, to record by the Bell method of visible speech. They are always accompanied with marked facial and often manual gestures. She thus often expresses feelings which she wishes to conceal, as well as shades of feeling too slight and subtle for the fingers. On being questioned she insisted that she could "*think*" three noises—even a very loud and disagreeable howl of anger which she has been heard to utter but two or three times in her life—without making them, but she could not make them without the feeling. By special request she tried several times with great complacency to make the "angry noise," but in vain. She once said, "When I think of Julia I think her noise and do not think to spell her name". Several of the emotional sounds were made during a dream, the pantomime of which was very expressive as she took her after-dinner nap upon the sofa. She is very positive that her nightly devotions are without vocal or manual signs. The devotions are very regularly performed and the signs, so far as could be learned, have never been observed. These interjectional sounds which her teachers have often striven, but only with partial success, to repress, are not loud or disagreeable, are readily intelligible, and, so far as the data for comparison exists, seem neither to have essentially changed in character or in pantomimic accompaniment, nor to have increased in number for many years. She feels that it is "not lady-like" to make them, and is glad to be corrected, but unless they are quite loud, cannot tell, even if her attention is directed to the matter, whether she really makes a noise, without placing her hand upon her throat. Pressing thus on the throat of several persons successively, she sometimes sportively attempts to imitate their voice with her own in a way which shows that she does distinguish differences of both loudness and pitch (paradoxical as the language may be) without any conception or sensation whatever of sound. That her emotional "noises" have any such philological importance as roots as Dr. Lieber and others have imagined, seems on the whole very doubtful. Aphasic patients sometimes use a set of new and strange sounds as designations of objects or as expressions of passion consistently and without change for years. True, her sounds have not been modified, as are the natural cries of those congenitally deaf but not blind, by imitating the motions of lips and tongue which they see others use: but the fact that she has once spoken is very viciating for such a view. Could however any inference whatever bearing upon this perhaps the most important and most difficult of all psychological questions, be drawn from such facts as the above, it would be that language originated not in the imitation of natural sound nor in the impulse to communicate with others but as a purely physiological reflex excited by the stimulus of outward impressions acting upon or through the senses.

She is not apt, like many defectives, to fall asleep if left alone or unemployed. Her sleep is perhaps lighter and shorter than the average. Several midday naps were observed. She first groped about the room to assure herself that she was alone, then lay down, her face upward and the right or talking hand folded in the other upon her breast. There was at first a slight and regular movement of the chin and toes, while the faint prolonged sound of 'oo' (as in 'fool') often accompanied expiration; slight epileptic twitches several times roused her to quite a pantomime of rapid, troubled and mostly unintelligible gestures; till at length she fell asleep with long, regular breathing, the teeth slightly apart, and the tongue pressed against and almost between them. Just before sleeping, a strong odour of eau-de-cologne and a drop of sugar solution, which she readily perceives when awake, applied respectively to nose and tongue, caused no apparent sensation, while the slight touch of a fine thread upon her face or hand roused her at once. It is possible she directs her attention to the cutaneous sense of these parts, as we often 'set the mind' to wake at a certain strike of the clock; or perhaps this sense is the last to fall asleep. Her sleep seemed almost never untroubled by dreams. Often she would suddenly talk a few words or letters with her fingers, too rapidly to be intelligible, just as others often utter incoherent words or inarticulate sounds. Movements of the lips were also observed, and the emotional expression of her face was constantly varied. She asserts that she dreams much, but finds it very hard to recall her dreams; insists that she has dreamed of hearing with her ears the angels playing in heaven, of seeing the sun so bright that her eyes ached, and of standing in

a large place surrounded by many people and seeing God afar off. In relating these dreams her manner is very earnest and intense, but if questioned how the music sounded, how the objects looked, she could give you no more detailed answer than "glorious," "beautiful," &c., and often became quite impatient at the scepticism implied in questioning her closely. She has many times dreamed of being awakened suddenly by animals touching her, or jumping upon her bed. If a normal person dreams in terms of touch, this sense is generally excited only at the end of a series. The dream begins in terms of sight or hearing, and rarely goes so far as contact. The suddenness of so many of Laura's dreams which begin and end in the domain of touch, thus indicates that her dreams are only in its language.

Most dreams are reflex phenomena due to the irritation of sensory nerves. Any or all of the five senses may be excited during the soundest sleep. If attention is directed to the darkest field of vision we can always see the light-chaos or dust *(Eigenlicht)*, or perceive a difference of intensity between the centre and periphery of the field. It would almost seem that modifications of retinal circulation, nutrition, temperature, &c., have a psychical side accessible to self-observation. Goethe could always see streaks of mist; Purkinje saw broad, bending bands, sometimes moving in concentric circles or breaking up into arcs and radii. To J. Müller, these moving spots of mist seemed coloured, they moved about from side to side of the field of vision, gradually took shapes quite disconnected from any objects of recent experience and finally passed into dream-images. Thus, from the nature of the light-chaos, we may account for the reduplication of dream-objects—swarms of birds, flies, stars, kaleidoscopic patterns, &c. H. Meyer and Patterson, on waking suddenly, have seen the after-images of dream-objects slowly fade through complementary colours. We may infer from such facts how strongly the higher centres sometimes react in dreams upon relatively slight stimuli of the lower. Hermann further concluded that those who were blinded by lesions of the peripheral organ gradually lost all distinct visual conception, first from the waking and later from the sleeping consciousness. Laura never has been and can probably never be taught to observe and note down her dreams with any such precautions as Wundt suggests; but a careful analysis of all dreams which she now remembers, or which others have recorded, yields no good ground for believing that she has ever had any kind of visual or auditory conceptions even while sleeping, when the immediate sensation is a still more minute, though perhaps no less indispensable, element of perception than in the waking state. Even her sexual dreams, there is every reason to believe after the most careful inquiry, have always been very few in number, and of so naïve and unspecific a character that only a psychologist would designate them by that name. Now that she has safely passed the most trying period of womanhood without more instruction on such subjects than was strictly necessary for her health, it seems on the whole not improbable that the strongest of all instincts has in her failed to mature, either in the waking or sleeping consciousness, into any distinct *à priori* notion of the ways and means of its own gratification.

Scherner has propounded the curious and improbable theory that dreams are symbolic of the constitution and functions of different parts of the body. All dreams, he asserts, are reflexes of organic feelings, and their types and genera are determined by the forms and positions of the organs. The intestines, *e.g.*, appear in dreams, "after the ego-power is scattered and dispersed," as streets and canals, the stomach as an enclosed or sequestered village or as a dark room with one or two round windows. The body as a whole is always a building of some sort. He dreamed of two rows of boys in red and white, rushing to fight each other, retreating and fighting again round after round. These are explained as the teeth, the involuntary grinding of which is supposed to have caused the dream. The lungs are objectified as a pair of regularly beating wings in dreams of flying, the heart is a fiery furnace, a stove, the sun, &c. Even colours as of the hair, the blood and bile, are reproduced. Not one of Laura's dreams can be satisfactorily interpreted by any of these rubrics. This test of Scherner's theory is of course not crucial, but if internal organs are ever represented in the consciousness of sleep, and especially if they are archetypal there, we should expect this to be peculiarly so in Laura's case: so that to all the psychological objections to such a theory her dreams add in some degree the force of an experimental refutation.

Wundt holds that all dreams, hallucinations, nocturnal insanities, &c., are automatic excitations of what he assumes as a *sense-surface* in the cortex caused by modifications of its circulation, and that they are thus reflexes, originating in the innervation-centre of the blood-vessels in the medulla. This may be true of many toxics and soporifics, and disorders of the blood-vessels and heart very often accompany or precede mental disease. It is an assured law of psychiatry that every functional or mental disturbance brings about anatomical changes in the brain, and thus dreams may even permanently affect the sanity of waking-hours. Hence, if we admit, upon the uncertain hypothesis of Hughlings Jackson, that the development or nutrition of cortical cells is determined and limited by the

course of blood-vessels in the cortex, we should expect that the cells lying nearest them, and which we may fancy to represent the earlier acquisitions, are more immediately affected than those distant three or four removes and representing later acquirements and experiences. If this were true, we ought, according to Wundt, to dream mainly of the experience of childhood, and not of the preceding day, and it would be at least possible that forgotten events of early infancy should be reproduced. Dreaming and waking notions are related as species and genera, or as a more partial to a more perfect function. Attention, to the physiologist, is essentially the expression of an instinct. The mind pushes on from one impression to another by a native spontaneous impulse of growth and development. If we may conceive every thing psychical expressed in terms of inner tension, we may say that the direction and movement of attention is like the successive waking of the different elements of psychical life. In the sleeping consciousness, this process is mainly an automatic and central one. 'Inner work' has brought cells into unstable equilibrium, and excitability very easily becomes excitation. Where the work of repair is not done, the slight stimuli of the sleeping state is not sufficient to rouse them: where it is done, the almost spontaneous activity of rested cells easily raises their processes above the threshold of consciousness. These are of course fresh and healthy morning dreams, while only those cells which had suffered the greatest fatigue, or which, long after the outer senses slept, had been morbidly prevented from restfully sinking below the threshold to the inner work of repair by the persistence of mental after-images of recent events, may be said still to wake. Now in the waking state the activity of the senses brings to bear an environment with which the normal action of the centres, if acting only by their own law of rest and fatigue, is more or less inconsonant. Not only can attention not always be accommodated to its object beforehand, but certain centres are disproportionately exercised. In sleep all the centres have a greater degree of physiological freedom. Possibly Laura vaguely strove to express this distinction in a line of one of her so-called " poems," *viz.*:—" A good sleep is a white curtain, a bad sleep is a black curtain ". All the intellectual work she has ever known has been scarcely more than the exercise of what Mr. Spencer calls the *play-instinct*. What she has done has been spontaneous. The sudden arrest of peripheral activities of the higher senses, leaving their centres under conditions which perhaps kept them exceptionally unatrophied, may have raised the level of cell-equilibrium, so that she both wakes and sleeps on a higher plane of cerebral rest and nutrition. This at any rate is not inaccordant with the remark of the physiologist Burdach, who, in comparing the accounts of ten blind and deaf mutes, argued that Laura's remarkable understanding was due to "the creative elaboration of impressions unprecedentedly limited in variety".

To distinguish what was native from what was adventitious in Laura's moral, and especially in her religious, development was one of Dr. Howe's chief interests. He had no Rousseau-like expectation that perfect goodness would result from her unprecedented isolation; still less had he any wish, as was sometimes fanatically urged against his method, to retard the unfolding of her mind in either of those directions. He only required her teachers to refer Laura to him for answers to her occasional questions upon these subjects, and sought in every way to shield her from dogmatic indoctrination. The early record of her fresh and original intuitions, of her curious approaches to questions regarding the nature and necessity of a First Cause, of the unaccountable development of her conscience, all so essentially correct yet so unconventional, excited great interest at a time and among people where the central question of theology and philosophy was to determine what factors of consciousness were due to experience and what were *à priori* or intuitive. About 1845, soon after his return from some months' sojourn in Europe, Dr. Howe was quite disheartened to find the mind which he had laboured so long and devotedly to develop in the way which he believed to be at the same time best for it and most instructive to the world, cobwebbed with the barren formulæ and conventionalised by the shallow sentiments of one of the popular orthodoxies of the day. "I hardly recognised," he said, "the Laura I had known." We should not be greatly surprised if his interest in her became gradually less as she fell more under the influence of her new spiritual guides, and thus grew month by month less original and less interesting. Nothing can exceed the crudeness of the Bible translated into terms of her one sense of touch. "Is not the Lamb of God grown to a sheep yet?" "Will Jesus carry us in His arms so?" (with the gesture of a mother embracing her child). "Was not Thomas right wanting to feel the wounds of the spear?" These and many other similar questions are on record, attesting at the same time her native curiosity and the poverty of her conceptions. It would seem, as far as can be learned, that since the time of her conversion and admission with immersion into the Baptist Church her disposition has grown sweeter and her temper more uniform. But when one takes the trouble to enumerate the facts of the New Testament and the cardinal Christian doctrines with their standard forms of illustration, of which she can have even no childish conception, it is seen how minimal the intellectual element of faith may be;

while if, on the other hand, with Schleiermacher, we consider the essence of Christianity to be the formulation of the instinct of dependence so unprecedentedly strong both by nature and education in her, we shall possibly wonder less that so many of her friends have found edification in her numerous conversations and letters concerning her religious experience and belief.

The above is very far from exhausting even in epitome the interesting points suggested by the study of this remarkable case. Laura has very little idea of the interest she has excited in the world; is intensely delighted to see her friends, or to receive any little attention or remembrance from them; and is so good-hearted that the writer is pleased to state in closing that, in spite of the weeks of annoyance to which his experiments subjected her, she was always cheerfully ready at the appointed time, and still cherishes only the kindliest sentiments towards her tormentor.

G. STANLEY HALL.

NOTE.—A question of great interest, suggested by the Editor with reference to a note in Whateley's *Logic*, is how far has Laura been able with the help of her means of expression to form concepts proper, and how far her thinking is able to proceed without the help of her manual marks and signs. Whateley's statement (foot-note to Introduction, § 5) that slight and unintelligible motion of the fingers can generally be observed when she is musing by herself, is not in accordance with the writer's observation. She often sits alone apparently absorbed in thought and reflecting her emotions in smiles, frowns, &c., and with no movement whatever of the hand, although the latter is sometimes observed. If we consider that all impressions above those of touch, which others apprehend in the form of sensuous images must be thought by her, if at all, as general conceptions, it seems probable that her thinking does range beyond the individual objects of *her* sense without finding signs necessary as instruments of thought. This conjecture is strengthened by the general intelligence which appears to have characterised her childhood before her education began.

G. S. H.

II.—HARMONY OF COLOURS.

IN an acute and interesting article "On Discord," published by Mr. Edmund Gurney in the last number of this Review, there are one or two very sensible remarks on the difficulty of reducing the effects of colours in combination to simple physiological and psychological laws. These difficulties, as Mr. Gurney observes, "are almost enough to make one despair of anything like an exact and complete *rationale* of colour-discords and affinities". Mr. Gurney is here only concerned with the obstacles in the way of interpreting the facts: he does not touch on a

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